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INSPECTION OF MILK SUPPLIES

ERNEST KELLY
In Charge, Market Milk Investigations, and
C. S. LEETE
Market Milk Specialist, Dairy Division, Bureau of Animal Industry

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IMPORTANCE OF MILK INSPECTION.

Until a comparatively recent time milk inspection was almost exclusively a matter of detecting adulteration, watered milk being the most common form. This phase of inspection still exists and is important, for vigilance is necessary to prevent such practices. In many places, however, the inspection is so efficient and so well established and the danger of detection so great that the number of violations of the law against adulterating milk grows relatively less.

The work of milk inspection has broadened in recent years and now includes more than the detection of adulteration, though many people in their ordinary use of language do not recognize this fact, and continue to speak of "pure milk" as milk that is not watered and contains no preservative. The bacterial content of the milk must always be taken into consideration when designating milk as

pure. The chemical, bacteriological, and sanitary aspects should not be confused. Each is essential in studying the purity of milk.

The science of bacteriology has made modern sanitary science possible and has disclosed factors hitherto unknown which affect the milk supply. Digestive disturbances are often associated with milk of high bacterial count due to dirt or age; and these disturbances may be serious if digestion is weak, as in the case of infants and invalids.

The bacteria increase rapidly when the milk is not properly cooled, and may be present in objectionable numbers in carelessly handled or old milk. It is an established fact that bovine tuberculosis may be transmitted to human beings, especially to children, through the milk supply, and that certain infections, fevers, and other diseases may be spread by means of milk. The risk in using milk has, perhaps, been overestimated at times, but that is no argument against taking proper precautions to safeguard the milk supply.

Vigilance in regard to the condition of the milk supply from the farm to the consumer is the function of present-day milk inspection. Such vigilance should be exercised by trained officials able to reach the core of such vital problems. Current literature on progress in milk and dairy bacteriology, sanitation, and the eradication of bovine tuberculosis, might well be included in health-department files. By keeping informed on such important subjects the health officer can know of progress made.

DEVELOPMENT IN THE CONTROL OF CITY MILK SUPPLIES.

There are three main factors in milk control of cities: First, dairy and milk-plant inspection; second, dairy instruction; third, laboratory control. In the final development these three features became practically merged into one.

Dairy inspection includes the use of the score card, and laboratory control helps to point the way for such work. As a rule, the smaller cities have not reached the stage of development shown by the larger cities. This may be due to two things: Lack of appropriation for milk control and the comparatively short length of time health control has been established. The larger cities, as a rule, have had supervision of milk supplies for comparatively long periods. Some cities as large as 50,000 population, however, have practically no facilities for such work.

The fact that small cities lack proper milk control is strongly emphasized in order that the attention of sanitarians and city officials may be directed to the needs of these communities.

Outside help is usually available from either State or Government specialists. Such aid may be necessary in order to show the people or the authorities the need for a safe milk supply, and suggest means for obtaining it.

There is no reason why small cities can not have a milk supply as good as, or better than, that of larger cities. In some small cities the authorities and the citizens themselves are alive to the situation and have obtained some of the best milk supplies in the country. This can be accomplished in a great number of small cities by energy, cooperation, and intelligent leadership, and without a large expenditure of money.

INSPECTION WORK.

DAIRY-FARM INSPECTION.

Dairy-farm inspection is of special importance in small cities, where the bulk of the milk is sold in the raw state and where laboratory facilities are not available, but adequate farm inspection is important for all milk supplies. It is especially important in communities where milk-control activities are being inaugurated, since the producer must be taught the proper methods to use in the production, handling, and transportation of milk.

Inspection of dairy farms furnishing milk to the larger cities is often impossible. This is regrettable, for supervision and control of the source of supply are desirable. The quality of the product

FIG. 1.—Inspection of dairy surroundings.

as it reaches the consumer, whether raw or processed, depends on the quality of the original milk. This can be controlled best by frequent and intelligent dairy-farm inspection.

Dairy-farm inspection has a broader meaning than looking into the dairy barn and reporting on light, ventilation, and the smoothness of walls and ceilings. Dairy-farm inspection means, first, coming into personal contact with the producer (Fig. 1) and establishing a personal relationship between control official and dairyman. In the vast majority of cases it means education instead of prosecution. When dairy inspectors prove to the dairyman that they have a detailed knowledge of milk production and handling, and when they can approach the problems of the dairyman with sympathetic interest, one of the important objects of milk-control work is accomplished.

Proper inspection of dairy farms furnishes evidence of disease in dairy cows and milk handlers. It supplies information regarding water supply and sewage disposal—both important public-health matters. It enables the official to judge by personal acquaintance with the dairymen the best means of accomplishing hoped-for results. By means of it he is able to bring about permanently by persuasion what might otherwise be accomplished temporarily only by more drastic methods.

INSPECTION OF CITY MILK PLANTS.

Formerly the principal activity of city milk-inspection staffs was to make chemical and bacteriological examinations of samples of milk from delivery wagons in the city and to pay regular visits to various dairy farms for the purpose of inspection and scoring. Owing to the rapid growth of the cities the dairy farms supplying them with market milk are not only more numerous but are located farther away so that it is almost physically impossible for ordinary milk-inspection forces to visit all of them two or three times a year. On this account and because of the fact that pasteurizing plants in the city have increased in numbers and importance, the duties of the milk inspector have become somewhat modified, and the inspectors, therefore, must spend more time at the city plants. Whenever any milk of doubtful quality is received, the dairy supplying it must, of course, be visited.

Modern inspection in the city includes the collection of samples, the making of chemical analyses, and examinations for temperature, dirt, and bacteria. This work necessitates a milk laboratory, which is essential for all milk-control work; for obtaining best results its work must be secondary to no other line. The following tests, at least, should be made: Sediment, butterfat, solids not fat, total solids, preservatives, acidity, and bacteriological analysis. The usual bacteriological examination is for "total count." The laboratory work indicates to a great degree of accuracy the condition of the milk supply.

INSPECTION OF PERSONNEL.

To carry on farm and city-plant inspection and analysis of samples, inspection and laboratory forces are necessary. The personnel of these forces should be chosen with great care.

As personal and official representatives of the agency which safeguards the health of a community, members of the milk-inspection force should appreciate the responsibilities of their position. The inspectors represent the law; they represent the board of health, which is or should be a powerful educational institution. The public, the producers, and the distributors are all vitally concerned in the work of the inspection force. Each group has its own point of view, interests, and problems, with which the inspector comes into personal contact. He meets each problem, and in dealing with it he is a spokesman for the board of health. In all his dealings he must remember that first and foremost the health of all must be placed above the problems of any individual. The problems of the individual, when worked out correctly, will always be in harmony with the purpose of the board of health, that is, the assurance that the public health is safeguarded.

Cooperation among the inspection force, the producers, and the distributors, and a constructive policy are the ideals to be attained. If such cooperative spirit exists the results will be permanent and satisfactory.

It is evident that inspectors should be well qualified to gain and hold the confidence which is so necessary for success. Training, both theoretical and practical, tact, a pleasing personal appearance, and a conscientious appreciation of his responsibilities are qualities which are required in an inspector.

The inspection force should be directed by a chief inspector or dairy commissioner. His duties should be to enforce the milk ordinance and to obtain an adequate and safe milk supply, to investigate the methods and processes of producing and marketing milk and other dairy products intended for consumption by the community. An applicant for this position should have special educational qualifications, and in addition several years' experience in investigational work connected with dairy sanitation or in enforcing dairy laws.

Inspectors should be appointed as the result of examination. The qualifications desirable for inspectors are:

A thorough knowledge of milk production and handling.
Scientific and practical knowledge of dairy cattle, feeding, breeding, and management.
Training in dairy bacteriology.
A thorough knowledge of the factors which control quality, quantity, and healthfulness of milk.
A knowledge of dairy chemistry.

The duties of an inspector are to assist the chief inspector in enforcing the provisions of the local milk ordinance: to inspect dairy farms, milk-receiving stations, and city milk plants; to collect samples of milk and other dairy products, and to instruct milk producers, milk dealers, and others in the proper methods of handling milk.

Without qualified and efficient men in the positions of chief inspector, assistant inspector, and analysts, milk-inspection work can not be of the highest order.

MILK ORDINANCES.

A milk ordinance regulating the production, handling, and sale of milk, cream, and other dairy products is essential for all communities.

For the proper safeguarding of the milk supply of a community a suitable and enforceable law must first be enacted. The ordinance is the instrument which gives the health department authority to supervise and control the milk supply. In general, it must cover three distinct phases: First, fraud; second, disease; and, third, cleanliness in the production and handling of milk. One of the most important considerations must be the reasonableness of the law. A law which works a special hardship on a legitimate industry is not reasonable, and defeats its own purpose.

A study of the milk ordinances of a great many cities, large and small, shows that there is a great diversity of opinion among lawmakers and their advisers as to what constitutes a proper milk ordinance. There is certainly a great lack of uniformity among the laws, some of which are entirely out of date. Many of them seem to be

transcripts of ordinances in force in other cities, placed in the municipal series of laws without regard to local conditions. Some of them contain provisions which are unnecessary and unreasonable and which can not be enforced.

In a strict sense it is impossible to frame a milk ordinance, with its definitions, standards, and requirements, which will be suitable for all communities. On the other hand, a general skeleton form may be made that can be used as a framework upon which to build a finished, practicable, operative law. No local lawmaking body should attempt to draft a milk ordinance, with its standards, grades, and requirements, unless it is entirely familiar with local dairy and milk conditions, as well as with the purposes and intent of such an ordinance. A special study by competent persons should be made. In that way only can satisfactory standards—chemical, bacteriological, and sanitary—be prescribed.

With these ideas in view, the United States Department of Agriculture has prepared a form of milk ordinance which, if enacted and properly enforced, will give the community a law for bettering its milk supply. This ordinance is restricted to the production, handling, and sale of milk and cream. As such it consists of eight sections, and takes into consideration definitions, standards, grades, adulterations, the making of regulations, collection of samples, and penalties.

A special feature of the ordinance is the grading of milk and cream. Grading is necessary and is of paramount importance. One of the great sanitary and economic questions will be solved if practical grading of milk, with the consequent grading of selling price, can be enforced. Three grades are considered—Certified, grade A, and grade B. Pasteurization is compulsory for grade B, but optional for the other grades. Grades A and B represent the largest quantities of milk sold. No definite general score or bacterial requirements can be made to cover all conditions. Some communities, long under competent health jurisdiction, can enact and enforce more stringent laws than other communities not so fortunate. The health department must determine from its own experience the score and bacterial count for grades A and B. Grade A must be of such quality that there will be no question as to its purity and safety. Grade B can be of lower grade than A, because pasteurization is obligatory. No grade below that of B is recognized.

Another wise provision gives health authorities the right to make regulations for the further proper enforcement of the ordinance. Rules or regulations can define more fully and add necessary detail and can be passed and amended without the difficulty encountered in dealing with general lawmaking bodies. They can give details for the issuing of permits, for the examination of herds and milkers for disease, and for the cleanly production and handling of milk. They can not, however, go beyond the scope expressed in the ordinance itself.

This draft of an ordinance will prove to be a satisfactory framework upon which the average town or city can build a finished, practicable law, which, if properly enforced, will improve the average milk supply and work toward a desired uniformity of food laws.

FORM OF ORDINANCE.

An Ordinance to Regulate the Production and Sale of Milk and Cream, and for Other Purposes.

SECTION 1. Be it ordained by the ——— of the city of ———, That for the purpose and within the meaning of this ordinance, (*a*) "milk" is the lacteal secretion obtained from the complete milking of cows; (*b*) "skimmed milk" is milk from which substantially all the milk fat has been removed; (*c*) "certified milk" is milk produced and handled in conformity with the "Methods and Standards for the Production and Distribution of Certified Milk," adopted by the American Association of Medical Milk Commissions May 1, 1912, and amendments thereto, in effect at the time of production, and certified to by a milk commission constituted in compliance therewith; (*d*) "grade A milk" is milk produced from healthy cows, as determined by the tuberculin test and physical examination within not exceeding one year previously by a qualified veterinarian, from dairies that score not less than ——— on the dairy-farm score card in current use at the time by the United States Department of Agriculture, which milk shall not, at any time, contain more than ——— bacteria per cubic centimeter. All persons coming in contact with the milk or milk utensils must be medically inspected, and such inspection must have the approval of the board of health; (*e*) "grade B milk" is milk produced from healthy cows, as determined by physical examination within not exceeding one year previously by a qualified veterinarian, from dairies that score not less than ——— on the dairy-farm score card in current use at the time by the United States Department of Agriculture, which milk shall not, at any time, contain more than ——— bacteria per cubic centimeter; (*f*) "pasteurized milk" is milk which has been heated to and for at least 30 minutes held at a temperature of 145° Fahrenheit; (*g*) "cream" is that portion of the milk, rich in milk fat, which rises to the surface of the milk on standing, or is separated from it by centrifugal force, and containing not less than ——— per cent of milk fat; (*h*) "homogenized," or "emulsified," milk or cream is milk or cream which has been subjected to the mechanical process of homogenization, or of emulsification, as the case may be; (*i*) "unsterilized containers" are containers which either have not been subjected to moist heat at a temperature as high as 205° Fahrenheit for two minutes or longer or do not comply with such alternative requirements. to be prescribed by the regulations made pursuant to this ordinance, as may be necessary to effect sterilization thereof; and (*j*) "person" imports both the plural and the singular, as the case demands, and includes corporations, partnerships, societies, and associations.

When construing and enforcing the provisions of this ordinance, the act, omission, or failure of any officer, agent, or other person acting for or employed by any individual or by any corporation, partnership, society, or association, within the scope of his employment or office, shall in every case be also deemed to be the act, omission, or failure of such individual, corporation, partnership, society, or association, as well as that of such officer, agent, or other person.

SECTION 2. That no person shall sell or deliver for consumption as milk or cream or have in his possession with intent to sell or deliver for consumption as milk or cream either—

(*a*) Milk or cream to which water or any foreign substance has been added; or

(*b*) Milk containing less than ——— per cent of milk fat or less than ——— per cent of solids not fat, or cream containing less than ——— per cent of milk fat, unless such milk or cream is plainly and conspicuously labeled "Subnormal," together with a statement showing the actual per cent of milk fat contained therein; or

(*c*) Skimmed milk which has not been pasteurized or made from pasteurized milk, or which is not labeled "Skimmed milk"; or

(*d*) Milk or cream containing, or which has been exposed to, any disease-producing bacteria; or

(*e*) Milk or cream the container of which is labeled or branded so as to mislead or deceive the purchaser; or

(*f*) Milk or cream produced from diseased cows or from cows during the period of 15 days preceding parturition, or within such time thereafter as the

milk is abnormal, or from cows which have been fed unwholesome food or have had access to contaminated water; or

(*g*) Milk or cream which falls below the requirements of grade B, as defined herein, or milk or cream which has been produced, stored, handled, or transported in any unclean or insanitary manner; or

(*h*) Milk or cream the retail, or the final, container of which does not bear a plain and conspicuous statement showing the kind and grade as herein defined; or

(*i*) Milk or cream in unsterilized containers; or

(*j*) Milk or cream which such person has kept at a temperature higher than 50° Fahrenheit; or

(*k*) Grade B milk which has not been pasteurized; or

(*l*) Homogenized milk or cream, or emulsified milk or cream, unless it is plainly and conspicuously labeled "Homogenized," or "Emulsified," as the case may be; or

(*m*) Milk which has had the cream line increased by any artificial means; or

(*n*) Milk or cream made by combining milk powder and water, with or without the addition of butter or butterfat, unless it is plainly labeled "Remade," or "Reconstituted."

SECTION 3. That nothing in this ordinance shall be construed to prohibit the sale, when labeled so as to show its true character, of either (*a*) sour milk or sour cream; or (*b*) buttermilk, or any similar product made from pasteurized milk or cream; or (*c*) modified milk if made from milk or cream equal at least to grade B.

SECTION 4. That no person shall sell or deliver, or have in his possession with intent to sell or deliver, for consumption as milk or cream, any milk or cream without a permit from the board of health of ———.

SECTION 5. That the board of health of ——— is authorized to make such regulations, from time to time, as are necessary for the efficient execution of the provisions of this ordinance, and to issue permits to sell and deliver milk or cream in ———. The board of health, after affording the permittee an opportunity for a hearing, may suspend or revoke any permit issued by it under this ordinance whenever it shall determine that the permittee has violated any of the provisions of this ordinance or of the regulations made hereunder, and, without affording such opportunity, may suspend such a permit temporarily whenever it deems necessary.

SECTION 6. That the board of health of ———, its members, officers, and agents, shall have access at all reasonable times to any dairy or any other place where milk or cream is produced for sale; to any wagon, truck, train, car, warehouse, or station in which milk or cream for sale is being transported or is being held for transportation or delivery; and to all establishments, plants, depots, or stores where milk or cream is kept or stored for sale. Any person who hinders or prevents such access shall be guilty of a violation of this ordinance.

SECTION 7. That any producer, handler, or seller of milk or cream, whether principal, agent, or employee, who, on demand, refuses to sell or deliver a sample, not to exceed one pint, of milk or cream in his possession to any official designated by the board of health to collect samples, shall be guilty of a violation of this ordinance.

SECTION 8. That any person violating any of the provisions of this ordinance, on conviction by any court of competent jurisdiction, shall be punished by a fine of not more than ——— dollars, or by imprisonment of not more than ———, or by both such fine and imprisonment, in the discretion of the court; and for each subsequent offense, and conviction thereof, shall be punished by a fine of not more than ——— dollars, or by imprisonment of not more than ———, or by both such fine and imprisonment, in the discretion of the court.

SCORE-CARD SYSTEM IN DAIRY-FARM INSPECTION.

In the early development of dairy-farm inspection it was realized that it would be necessary to devise some system to insure uniformity. Originally the milk-control official visited the dairies, made comments, and took notes for future reference. There was no system of

comparison between dairies and no method of determining their sanitary rating or standing in the community.

The first score card in which a numerical rating was given was developed in 1904. During the next three years a committee from the Official Dairy Instructors' Association studied the situation and evolved the general outline of the card now in use by the Bureau of Animal Industry, and known as the official score card. The merits of this card were recognized from the first, and its use has spread until now many cities, State departments, and educational institutions carry on work with the aid of the dairy-farm score card.

THE DAIRY-FARM SCORE CARD.

The essence of the score-card system is the assigning of a number of points to as many conditions as possible, and the mathematical rating of each condition. The more detailed the card the nearer it is to the essential spirit or underlying philosophy of the system. It is like an appraisal of the stock of goods in a store or the property on a farm; the more carefully each item is valued and the less there is of lumping a number of items as miscellaneous or general conditions the more accurate the result.

The score card is not a set of peremptory orders, but a system of giving credit for good conditions and cutting or marking down for bad ones. It does not ask or expect a dairy farm to be perfect, but rates it as it finds the equipment and methods used.

The following is the latest edition of the score card recommended by the Department of Agriculture and the Official Dairy Instructors' Association:

[Front of card.]

[United States Department of Agriculture, Bureau of Animal Industry, Dairy Division.]

SANITARY INSPECTION OF DAIRY FARMS.

SCORE CARD.

Indorsed by the Official Dairy Instructors' Association.

Owner or lessee of farm_____

P. O. address_____ State_____

Total number of cows_____ Number milking_____

Gallons of milk produced daily_____

Product is sold by producer in families, hotels, restaurants, stores,

to _____dealer.

For milk supply of_____

Permit No. _____ Date of inspection_____, 192

REMARKS:_____

_____

_____

(*Signed*)_____

Inspector.

[Back of card.]

Equipment.	Score. Perfect.	Score. Allowed.	Methods.	Score. Perfect.	Score. Allowed.
COWS.			COWS.		
Health	6	.....	Clean	8	.....
Apparently in good health	1		(Free from visible dirt, 6.)		
If tested with tuberculin within a year and no tuberculosis is found, or if tested within six months and all reacting animals removed	5		STABLES.		
(If tested within a year and reacting animals are found and removed, 3.)			Cleanliness of stables	6	.....
Food (clean and wholesome)	1	.....	Floor	2	
Water (clean and fresh)	1	.....	Walls	1	
STABLES.			Ceilings and ledges	1	
Location of stable	2	.....	Mangers and partitions	1	
Well drained	1		Windows	1	
Free from contaminating surroundings	1		Stable air at milking time	5	.....
Construction of stable	4	.....	Freedom from dust	3	
Tight, sound floor and proper gutter	2		Freedom from odors	2	
Smooth, tight walls and ceiling	1		Cleanlines of bedding	1	.....
Proper stall, tie and manger	1		Barnyard	2	.....
Provision for light: Four sq. ft. of glass per cow	4	.....	Clean	1	
(Three sq. ft., 3; 2 sq. ft., 2; 1 sq. ft., 1. Deduct for uneven distribution.)			Well drained	1	
Bedding	1	.....	Removal of manure daily to 50 feet from stable	2	.....
Ventilation	7	.....	MILK ROOM OR MILK HOUSE.		
Provision for fresh air, controllable flue system	3		Cleanliness of milk room	3	.....
(Windows hinged at bottom, 1.5; sliding windows, 1; other openings, 0.5.)			UTENSILS AND MILKING.		
Cubic feet of space per cow, 500 ft.	3		Care and cleanliness of utensils	8	.....
(Less than 500 ft., 2; less than 400 ft., 1; less than 300 ft., 0.)			Thoroughly washed	2	
Provision for controlling temperature	1		Sterilized in steam for 15 minutes	3	
UTENSILS.			(Placed over steam jet, or scalded with boiling water, 2.)		
Construction and condition of utensils	1	.....	Protected from contamination	3	
Water for cleaning	1	.....	Cleanliness of milking	9	.....
(Clean, convenient, and abundant.)			Clean, dry hands	3	
Small-top milking pail	5	.....	Udders washed and wiped	6	
Milk cooler	1	.....	(Udders cleaned with moist cloth, 4; cleaned with dry cloth or brush at least 15 minutes before milking, 1.)		
Clean milking suits	1	.....	HANDLING THE MILK.		
MILK ROOM OR MILK HOUSE.			Cleanliness of attendants in milk room	2	.....
Location: Fre from contaminating surroundings	1	.....	Milk removed immediately from stable without pouring from pail	2	.....
Construction of milk room	2	.....	Cooled immediately after milking each cow	2	.....
Floor, walls, and ceilings	1		Cooled below 50° F	5	.....
Light, ventilation, screens	1		(51° to 55°, 4; 56° to 60°, 2.)		
Separate rooms for washing utensils and handling milk	1	.....	Stored below 50° F	3	.....
Facilities for steam	1	.....	(51° to 55°, 2; 56° to 60°, 1.)		
(Hot water, 0.5.)			Transportation below 50° F	2	.....
			(51° to 55°, 1.5; 56° to 60°, 1.)		
			(If delivered twice a day, allow perfect score for storage and transportation.)		
Total	40	.....	Total	60	.....

Equipment ..... + Methods ..... = ... Final score.

NOTE 1.—If any exceptionally filthy condition is found, particularly dirty utensils, the total score may be further limited.

NOTE 2.—If the water is exposed to dangerous contamination, or there is evidence of the presence of a dangerous disease in animals or attendants, the score shall be 0.

Directions for using dairy-farm score card.—The card has separate columns for equipment and methods and allows a total of 40 and 60 points, respectively. This arrangement of points is made for the purpose of emphasizing the importance of good methods and giving credit for cleanliness. A person may be handicapped by poor buildings which he has inherited or leased and which he can not afford to rebuild; but he can be clean. Painstaking methods, particularly in regard to cleanliness, give a creditable score in spite of poor equipment.

Health of cows.—Every individual cow in a herd should be sound, healthy, and well nourished. Physical disability of any description, such as enlarged glands, lumpy jaw, running sores, inflamed or defective udder or teats, makes a perfect score impossible. A deduction should be made in the score in proportion to the number and importance of the defects found. In some instances the especially dangerous condition of a single cow, from the standpoint of healthful milk, may justify a score of zero for the entire herd or dairy.

The methods to be employed and desirability of obtaining definite knowledge regarding the existence or nonexistence of tuberculosis are indicated on the score card. If the herd has been tested with tuberculin within the year and no tuberculosis found, or within six months and all reacting animals removed, the score will be perfect, and 5 points are allowed. If tested within the year, but not within six months, and reacting animals are found and removed, 3 points are allowed.

Feed.—Feed should be free from mustiness and from offensive decomposition. Decayed silage, brewers' fermented grains or distillery slops, or moldy or dusty hay should reduce the score. The improbability that by-products resulting from the manufacture of beverages will be fed properly has led many authorities to condemn feeding such products. Under ordinary circumstances when they are fed moist the score for feed should be reduced to zero, and often a further reduction should be made under the item "Stable air at milking time."

Water.—Drinking water for cows should be fresh and uncontaminated. Danger of pollution from the drainage of barnyard, manure pile, or privy will reduce the score, as should unprotected wells and stagnant pools. If the water tank, trough, or other receptacle is not kept clean, the score can not be perfect. The water supply should be so convenient to the stable as to make it unnecessary to expose cows to severe storms or extreme cold, and should be so abundant as to remove any doubt as to the ability of each animal to satisfy its thirst.

Location and construction of stable.—Cow stables should have a well-drained location. This does not relate to construction; a score should be reduced when the site is not drained, as when a barn is built in a depression or on level land which is not underdrained. The stables should also be free from contaminating surroundings. Privies, horse stables, chicken coops, stagnant water, etc., when near enough to pollute the stable air, should reduce the score. Provision is made in another place for a reduction of the rating when the

barnyard (Fig. 2) is unclean and poorly drained, although when conditions are exceptionally bad an additional cut can be made here. A yard may be so dirty as to be a contaminating adjunct of a stable.

The stable should have a tight, sound floor, incapable of absorbing liquids to any appreciable extent. An earth floor is undesirable. Back of the cows there should be a gutter, preferably of concrete, 16 inches wide and 8 inches deep; this is large enough to hold the droppings and prevent them from soiling the cows. It should have sufficient incline to drain readily, unless the liquid manure is taken up by absorbents. Some form of swing stanchion is the best kind of tie, as it allows freedom and tends to keep the animals out

FIG. 2.—Observing condition of barnyard.

of the gutter. The manger should be as simple as possible; cumbersome construction allows dust to collect, prevents circulation of air, and is difficult to keep clean. When mangers are of wood the angles, joints, and cracks are especially liable to be dirty. A concrete or nonabsorbent trough or a smooth floor answers the purpose of a manger and is given the highest score. Walls and ceilings should be smooth and tight; deductions in the score should be made for exposed crossbeams, bridging, braces, shelves, niches, ledges, and anything which might harbor dust.

Provision for light.—An abundance of light destroys bacteria, promotes the health of animals, and encourages cleanliness. In scoring for this item consider the number of stanchions rather than the number of cows which happen to be in the barn at the time of inspection. The score is for the means by which the light is obtained as well as the amount. The perfect means of lighting

the stable, as of lighting the residence, is by glass windows, and a perfect score can be obtained where there are at least 4 square feet of glass to each stanchion. Sometimes a stable is well lighted on only one side or at one end; in such case a deduction should be made from the score for uneven distribution.

Bedding.—Cows should be bedded so as to promote their comfort, especially where the floor is of concrete, but the bedding should not be of such nature as to contaminate the milk easily. From a sanitary standpoint clean shavings are highly desirable. Loam, sand, and dried muck are not recommended because of the dust created and the great difficulty in keeping them out of the hair of animals. Horse manure should never be used for bedding. Dusty or moldy hay or straw does not allow a perfect score. The quantity of bedding is scored under equipment; the cleanliness of the bedding and its proper use are scored under methods.

Ventilation.—On the score card the item of ventilation is subdivided into three sections. The first relates exclusively to the means for providing pure air; the second to prevention of excess of impure air due to overcrowding of animals; the third to the efficiency of the method used for conserving animal heat as needed for maintaining a proper temperature. The more nearly automatic any system of removing impure air and admitting fresh air is the better. No system is absolutely automatic, but to be scored as perfect it should have some kind of controllable flues or their equivalent. The King system is the most generally known system of ventilation and when properly installed, in working order and with sufficient capacity for the number of stanchions in the stable, gives satisfactory results. In describing outlet flues Professor King says, "There should be not less than 30 square inches per head when the outlet has a height of 30 feet above the ceiling of the stable." This duct should work on the principle of a chimney, and the higher it is the greater the draft or suction; consequently if this outlet is of less height, the cross-section area should be greater, while if it is higher, the area may be less. An outlet 20 feet above the ceiling requires about 36 square inches for each stanchion, according to Professor King.

The system of ventilating by windows swinging in at the top is sometimes used, although it is not quite equal to the King system, and therefore warrants a somewhat lower score. A sliding window should receive much less in scoring. Hay chutes, large spaces in the loft, and even cracks in the boarding on the side might receive some slight consideration on account of admission of pure air, but would deserve a cut under "Provisions for controlling temperature."

A stable in which cows have been kept overnight should be comfortable in the morning, without disagreeable odors. The item relating to controlling stable temperature refers to the adaptability of the means of providing fresh air to keeping the cows comfortable. For instance, a stable in which the supply of pure air comes entirely through wide cracks in the boarding, admitting drafts on the cows, would score nothing on this item. Dependence upon sliding or hinged windows might also reduce the score, because they frequently admit air in drafts on the cows, or make it difficult to control tem-

peratures. A stable having a roof of the monitor type would sometimes become uncomfortably cold under northern conditions by allowing too much heat from the cows' bodies to escape, and therefore it would call for a reduction of the score, while in the South the same condition would be rated perfect.

An overcrowded barn produces discomfort, is hard to keep clean, and usually contains impure air. A proper amount of space per animal, to receive a perfect score, is considered to be 500 cubic feet. In scoring for cubic feet of air space consider the number of stanchions rather than the number of cows which happen to be present at the time of inspection. A stable having 50 stanchions with 15,000 cubic feet of space should be regarded as having 300 cubic feet per cow. An excessive amount of space for each animal dissipates the heat from the cows' bodies and may be as bad as overcrowding. Under northern conditions if the cubic space for each cow exceeds 800 feet, a reduction should be made in the score for "controlling the temperature."

Professor King, in his book on ventilation, frequently qualifies his statements by such clauses as "in cold climates." Throughout eastern North Carolina, South Carolina, Georgia, the Gulf States, two-thirds of Texas, southern New Mexico, southern Arizona, and the western slope of the Pacific coast, runs an isothermal line showing 10° F. below zero as the lowest temperature ever recorded during a period of about 38 years. This line somewhat generally marks an average mean temperature of about 40° F. for January, the coldest month. Below this line the temperature is higher. In most of the section below this line, however, occasional chilly winds and storms call for protection of animals, and therefore some means of ventilation, a fact which is frequently overlooked by many milk producers in portions of the South and on the Pacific coast. In this southern belt the phase of ventilation dealing with conservation of animal heat is of little importance.

The stable should be scored (see Fig. 7) on the way in which it appears to be adapted to get results when those results are needed, and not merely on conditions at the time of the inspector's visit. For example, a stable without means of ventilation should be scored zero, even in summer when it is empty and the cows are in the pasture.

Utensils.—Utensils should be of metal with as few seams as possible. Seams which are unavoidable should be flushed smooth with solder. Rusty and battered strainers of wire or wire gauze, and strainers which are complicated or have parts that are hard to clean, should not be used. Small-top milk pails should be used, as they keep dirt out and facilitate the production of clean milk. The water supply for washing utensils should be clean, convenient, and abundant; the probabilities are that cleansing will not be thorough when the water supply is meager or inconveniently located.

A milk cooler and facilities for providing an abundance of steam or hot water should be in every milk room. Plenty of steam for sterilizing utensils is the perfect arrangement; but an abundance of hot water used at boiling heat is a good substitute. (Fig. 3.) The word "cooler" means one of the various appliances for passing milk

over a cold surface (Fig. 4). A tank in the milk house is not a "cooler," but it is better than nothing and will be serviceable, especially when milk is sold by the can, and might be allowed one-fourth point in scoring.

Milkers should wear clean suits, preferably white, to be used only when milking, and stored in a clean place when not in use.

Milk houses.—Every dairy should have a milk house or milk room (Fig. 5) fitted especially for the use to which it is to be put. Here the milk can be strained, cooled, bottled or canned, and stored, and utensils washed and cared for. If possible, the washing of utensils and the handling of milk should be done in different rooms. The milk house, if attached to the barn, should have an independent out-

FIG. 3.—Examination of utensils.

side entrance; if entered from the barn, it should be through a well-ventilated passageway with a self-closing door at each end, only one of which is to be open at a time. The milk house or milk room should not be near the hogpen, manure pile, privy, or anything that might be a source of contamination or afford breeding places for flies. The milk house should be light, well ventilated, and screened, and flies should never have access to milk or utensils. The floor should be smooth, preferably of concrete, sloping so as to give good drainage. Angles, as with the walls, should be rounded to prevent the collection and harboring of dirt. The walls and ceiling should be smooth and tight; concrete or tile wainscoting is desirable. There should be no dark corners or inaccessible places in the milk house. If the milk house has several rooms, the score should repre-

sent average conditions, giving special consideration to the room in which the milk is handled. Where there is a room in the stable in which the milk is poured from the milk pails to a carrier can, it should be considered a part of the milk house for purposes of scoring.

FIG. 4.—Taking temperature of cooled milk.

Cleanliness of cows.—When cows are carefully groomed (Fig. 6) and the long hairs on the flanks and udders closely clipped, they are considered clean and entitled to perfect score. Dust on bodies reduces the score slightly; large, easily visible particles of manure or mud decrease the score in proportion to the amount present. Deductions should be more severe when dirt is found on the flanks, udders, or teats.

FIG. 5.—Scoring milk house.

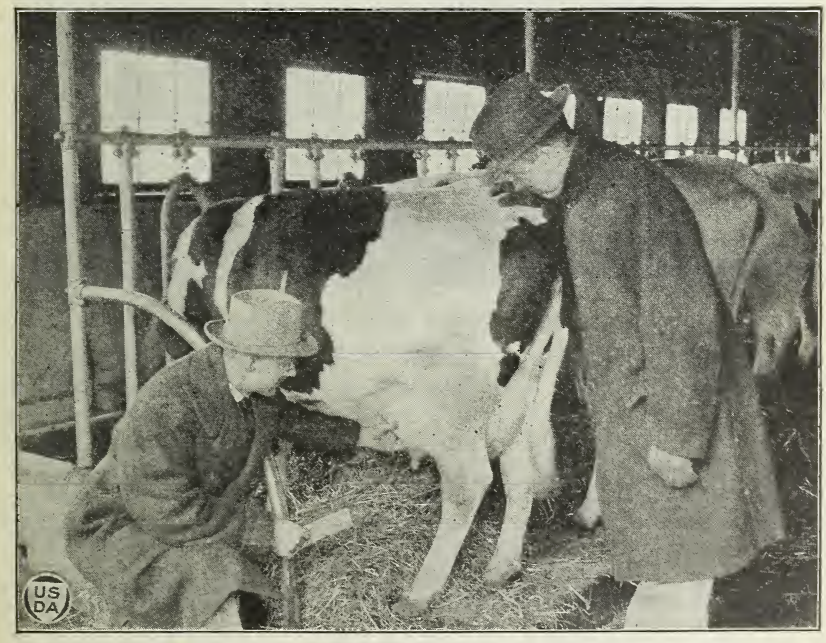

FIG. 6.—Examination of cows for cleanliness and physical condition.

Cleanliness of stable.—Stable floors should be kept clean by frequent and careful sweeping and washing. Walls should be free from dirt, especially manure. Joists, brackets, braces, stanchions, partitions, ledges, and ceilings should be clean and free from dust and cobwebs. All the places named should be examined for dust and cobwebs and scored accordingly. Mangers should be clean; there should be no dirt or fermenting feed in cracks and corners. Windows should be kept clean. In scoring a certified or high-grade dairy it is frequently necessary to make deductions of small fractions. The inspector should be extremely cautious about scoring any item absolutely perfect from the standpoint of cleanliness. (Fig. 7.)

Air in stable.—At milking time the stable air should be free from dust and odors. The air may be contaminated by lack of ventilation,

FIG. 7.—Scoring interior of barn.

too close proximity of horse stables, hogpens, and manure piles, by feeding silage or dusty feeds just before milking, by dusty bedding, by badly fermented feeds, and in other ways. When inspectors can not be present at the time of milking, a reasonably accurate estimate of conditions can be reached by general appearances and by questioning the person in attendance as to time and manner of feeding, milking, and the various other operations. If a dairy is scored several times a year, the inspector will obtain a correct idea of conditions.

Barnyard and manure.—The manure should be removed daily far enough from the stable to prevent odors from getting to the milk. There should be no accumulation of manure in the barnyard where the cows may become soiled by it. In order to merit a perfect score

the barnyard should be kept clean and reasonably dry. The ideal way is to remove the manure to the field daily; it prevents the breeding of flies and also proves to be actual economy in the conservation of plant food.

Cleanliness of milk room.—If the milk house has several rooms, the score of cleanliness must be based largely on the general conditions. Especial attention should be paid to the cleanliness of the room in which the milk is handled. This room should be used for no other purposes than cooling, canning, bottling, or storing milk; if it is used for general storage purposes or for anything but handling milk, the score should be materially reduced. When milk is stored or cooled in a tank, bad odors or foul water reduce the score. In some localities there is a growing tendency to introduce gasoline engines for power. When in the milk room, the liability for odors is such that they should cause a slight reduction in the score.

Cleaning utensils.—All utensils should be clean on superficial inspection; no dirt should be found in seams or places difficult of access. After the utensils are washed they should be sterilized with steam or boiling water for at least five minutes. The highest score can be given only where an abundance of steam is freely used. Boiling water can be used effectively as steam, but the ordinary equipment for heating water does not provide it in sufficient quantities to sterilize the utensils.

The utensils after being washed and sterilized should be inverted in pure air to drain and dry; if allowed to remain upright, dust may fall into them. Where a sterilizer is used a perfect score can be allowed if the utensils remain in it until used. Utensils should dry quickly from the heat of sterilization. Quick drying is of great importance because bacteria increase rapidly on moist surfaces.

Owing to the construction of milking machines, persistent care must be exercised in cleaning them. Each inspector should become acquainted with the construction, operation, and care of the various types of mechanical milkers. The following points should be watched closely in cleaning the machines: Rubber tubing, including glass unions; moisture traps; vacuum lines; teat cups and inflations; buckets; head; valve and pet cocks; sterilizing or soak solution.

Definite cleaning instructions should be followed by each milking-machine operator.

Heat sterilization of milking machines has proved to be very successful and is both simple and effective. The method follows. Immediately after milking rinse the machines with cold or lukewarm water drawn through the machines by vacuum. Break the flow occasionally by pulling the teat cups out of the water and then immediately immersing them again. This is done ten or twelve times.

The process is then repeated with hot soda solution. Teat cups and tubing are washed with a brush at this time. Units are then rinsed with clean water drawn through by vacuum. The long milk tube with claw and teat cups is then detached from head of pail. Air tubes (on inflation types of machines) are plugged, and the whole is placed in a tank of clean water, care being taken that all parts are entirely submerged. The water is then heated to a temperature of from 160° to 170° F. and held there from 15 to 30 minutes. The

water is then allowed to cool and the parts to remain there until the next milking. (A covered tank will usually hold the temperature above 160° F. for the required length of time, if heated to 165 or 170° F.)

The effect of heating on the rubber parts has not yet been fully determined by this department. So far, however, the temperatures used have not been any more detrimental to the life of the rubber than other methods of sterilization.

Bacterial counts obtained on comparative tests made with machines sterilized by this method and others sterilized in a chlorinated-lime solution have been in favor of the heat method for sterilizing. This

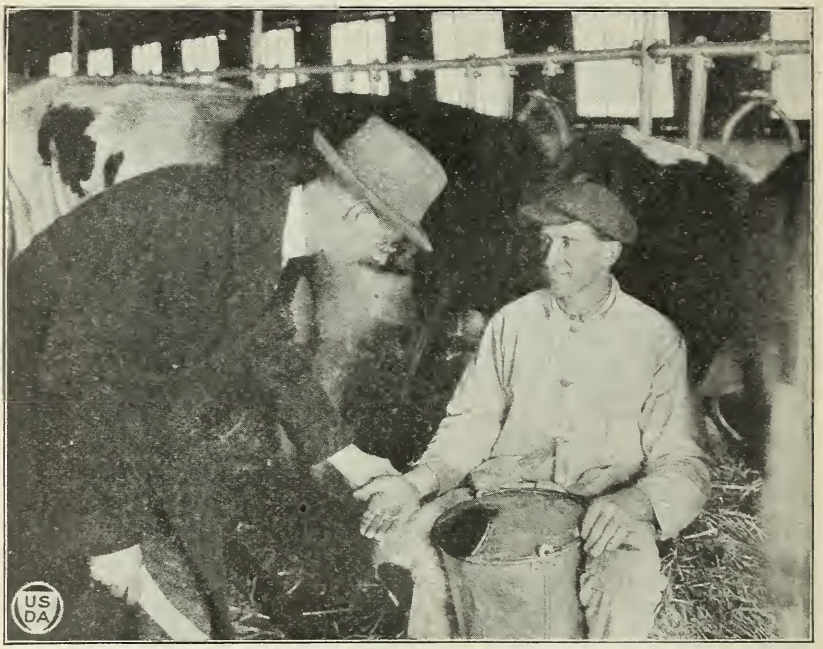

FIG. 8.—Inspecting milker's hands.

is undoubtedly due to the fact that the heat penetrates more thoroughly all the cracks and crevices.

Twice each week the machines should be taken entirely apart and washed thoroughly with brushes and hot soda solution. The vacuum line should be cleaned about every two weeks by drawing hot soda solution through it with vacuum. If milk is drawn into the vacuum line, the pipe should be cleaned immediately after milking.

Clean the moisture trap and check valve daily.

Milking-machine pails and covers should be thoroughly washed and sterilized after every milking.

In preparing the cows for milking, the same care must be used as in milking by hand. It is necessary that the teats be very clean if clean milk is to be obtained.

Milking.—Methods of milking must be cleanly. The milker should milk with clean, dry hands. The cows' udders should also be clean;

a perfect score should be given only when they are washed thoroughly and then wiped dry. Wiping with a moist cloth is the next best method; wiping with a clean, dry cloth or brush gives one point on the score if done several minutes before milking, so that the dust can settle before the milking begins. If after sitting down to milk the milker gives the udder a rub with his hands or a dry cloth,

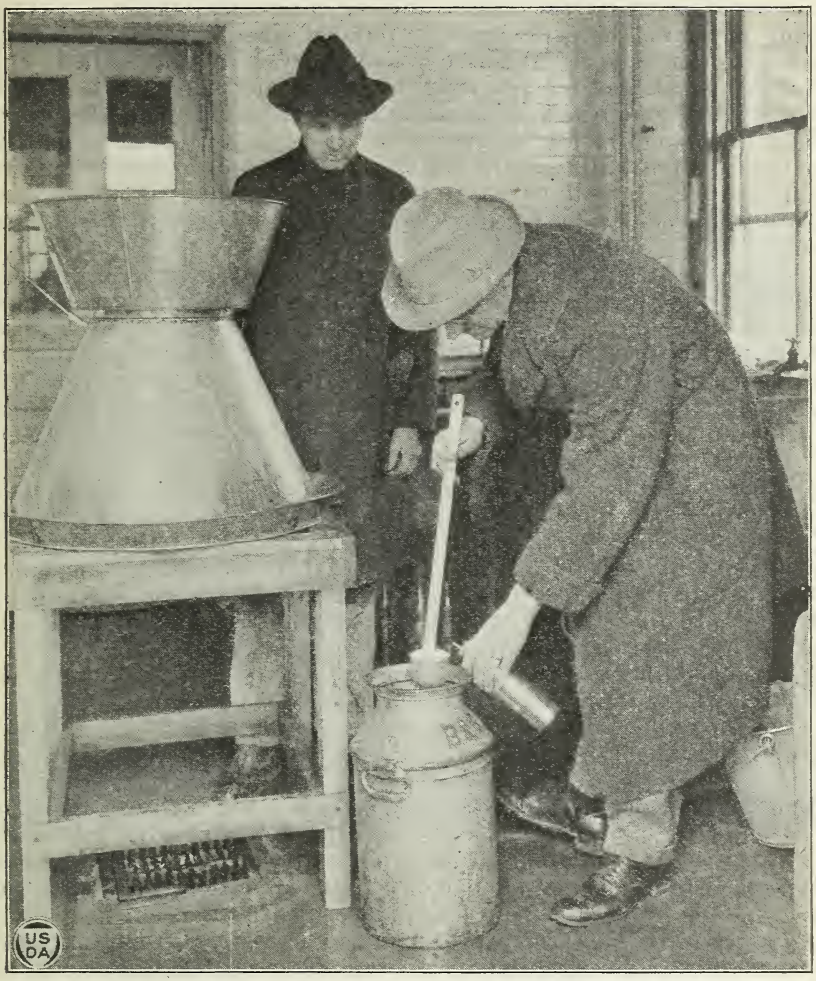

FIG. 9.—Demonstration of sediment test.

he may stir up dust that will fall back into the milk pail; such a method is generally worse than doing nothing and should have no credit.

It would be desirable to have all scoring done at milking time, but this practice is impracticable, as it would limit the work of the inspector to two or three dairies a day. Careful questioning by the inspector (Fig. 8), with close examinations, usually gives him a fairly

accurate idea of the method of milking. If, for instance, he is told that the udders are carefully washed daily, and inspection shows lumps of manure attached to the long hairs near the teats, only one inference is possible. Sediment in the milk or dirt on a strainer cloth tell the story of a dirty udder (Fig. 9).

Handling milk.—Milk should be immediately removed from the stable as soon as drawn, so that it will absorb no odors or dust. If for convenience several milkers fill one can in the stable, a perfect score could not be given even if the can when filled is promptly taken to the milk room, for it is bad practice to pour milk in the stable, and at least half a point should be deducted. When each can is filled and removed immediately to the milk house, however, the score should be higher than when the milk is allowed to remain in the barn until all the cans are filled. When two or more cows are milked to fill a pail which is then taken to the milk house, the score would not be perfect, but would be better than if the milk is poured in the stable air.

As soon as the milk reaches the milk room it should be cooled, which is done best by running it in a thin sheet over a surface kept cool by ice water. Spring water of a temperature under 60° F. has much merit for cooling milk, though it is not equal to ice water. Prompt and effective cooling is desired, and the advantages of such cooling more than offset any possible injury from the extra exposure of the milk to the air. Cans of milk are often placed in tanks of water. This is better than no cooling, especially if ice water is used, and deserves some score for both promptness and efficiency; but it is not so satisfactory as running the milk over a cooler as soon as each cow is milked; this is the only way to get a perfect score. Sometimes the evening milk is properly cooled and the morning milk is delivered warm. This practice gives one-half the score for cooling, provided the two milkings are not mixed, in which case the score would be zero.

The cleanliness of the persons who do the work in the milk house is allowed 2 points on the score card.

Storing.—The item of storing refers to conditions where the evening milk is held over for delivery in the morning. When the producer goes to the trouble and expense of two deliveries a day, as in some southern latitudes where ice is not plentiful, the extra delivery can offset the absence of storing facilities and give a perfect score on this item, though from the standpoint of economy ice is often less expensive than the second delivery. A temperature of 50° F. or below is the proper temperature for storage of milk or cream.

Transportation.—Transportation is to be scored from the same viewpoint as stables, namely, the adaptability of the method to the results desired when those results are needed. The word here means transportation so far as the producer is responsible, delivery to the railroad station, for instance. The transportation which is incident to distribution is not rated here.

ADVANTAGES OF SCORE-CARD SYSTEM OF INSPECTION.

Some of the advantages of the score-card system are:

A mathematical statement of conditions is more specific, accurate, and satisfactory than such words as "good," "excellent," "me-

dium," "fair," "bad." These words mean little or much, according to the ideals in the mind of the person using them.

The score-card system of inspection produces good results from the standpoint of the health officer, who represents the consuming public. It brings about great improvement in conditions. A minimum score can be established by ordinance, below which no dairy can be allowed to go if its product is to be sold in that city; at the same time the card stimulates those above the line to make further improvement.

The score-card system gains the good will of the producer and practically eliminates friction between him and the inspector, because everything is open and aboveboard. It gives no opportunity for favoritism, for any error or unfairness can be detected at once. Its openness is a protection to the producer against incompetent or

FIG. 10.—Furnishing dairyman with duplicate copy of score.

dishonest inspectors. It further wins the regard of the producer, for it awakens an interest in him and helps the one who wants to improve his conditions. Its effect is educational. The producer is given, in figures, a picture of all his conditions; he sees just what he should do to get a higher score and to improve his work, and it stimulates him to make improvements. It is advisable to leave a duplicate of the score with the dairyman (Fig. 10).

The system helps the health officer to supervise the work of inspectors and greatly reduces the opportunity for shirking, faking, or errors.

The system being a code of detailed instructions helps the inspector by telling him just what to do. It is the especial salvation of in-

experienced inspectors, because it places before them exact charts without which their work would be unsuccessful. This does not mean that the employment of such inspectors is advised, but they are sometimes appointed, and they should be helped as much as possible and the chances of their doing poor work reduced to a minimum. The ideal inspector knows so much about his business that he can not only make accurate scores but can give a reason for each item on the card and explain the figures; he is an instructor as well as an inspector. When instruction and inspection go hand in hand the best results are obtained. A city health department as such has nothing to do directly with the economics of milk production, but the inspector who has some knowledge of the subject can drop a word of suggestion which will help the producer to greater profits, and he advances his own cause by obtaining improvements in dairies under his supervision without friction or opposition.

The system controls the faddist or inspector who rides a hobby; he can give no more points for any one item than the score card allows.

The file of scores and tabulations becomes a valuable and useful set of records; it gives a permanent and accurate record of all dairies in convenient form and enables the health department to report to the public in definite figures what it is accomplishing. It shows physicians, consumers, and dealers who are the best producers.

The score card recommended by the Department of Agriculture is 5 by 8 inches and is one of the regular sizes of the various filing devices. In some cities the cards are filed alphabetically. In one city the cards are numbered consecutively and bound after being filled out. The numbers of the cards, dates, and scores of the different inspections are copied on smaller cards, a sample of which follows. These cards are filed alphabetically and give a dairyman's record at a glance.

Smith, John.		
Number.	Date.	Score.
1211	Jan., 1919	46
1329	July, 1919	50
1437	Dec., 1919	54

Because of its simplicity the score-card system of inspection has decided merit in connection with dairy laws and their enforcement. Many codes are a complicated and elaborate collection of rules covering all that is essential in producing perfect milk, and therefore they can not be enforced literally. A simple regulation that all dairies must be six-tenths or seven-tenths perfect according to the Government score card is more practicable, more easily enforced, more nearly just, and less liable to abuse than any other system. The score-card system can be made elastic, allowing the health officer a moderate course at first with a low minimum score for passing; later, with a higher score required, the system becomes more exacting.

Publicity of scores.—Publicity of scores is a stimulus to any dairyman, a valuable advertisement to the progressive producer, and often a great assistance to the consumer. It also encourages the better dairymen to continue to improve and calls public attention to the careless and slovenly. The latter by loss of customers or by act of the authorities will gradually improve or be forced out of business. Consumers who take an interest in their milk supply note the standing of different dairies and patronize dairymen who have good ratings. The quality of the milk supply of any city depends in a large measure on the consumer, and he can do much to encourage the production of good milk. Many cities issue weekly or monthly health bulletins, some of which show ratings of the various dairies.

Adaptability of the system.—Dairy conditions in different sections of the country are somewhat varied, particularly in respect to climate. The inspector must use his judgment in scoring factors which are apparently more important in some climates than in others. This refers especially to construction of the barns and ventilation. Increasing experience in all parts of the country, however, indicates that the need of modification of the score card is less than it would appear at first.

THE SCORE CARD IN RELATION TO BACTERIAL COUNT.

There is no direct relationship between the score card and the bacterial content of the milk produced on the farm. The score card records sanitary features and conditions and contains many desirable items, such as health of cattle, location of stable, and water supply, which, however, may have little effect on the bacterial count. The indirect effect of a sanitary stable, healthy cattle, pure water supply, and other items is of such importance as to warrant the importance given the score card.

WATER SUPPLIES.

The problem of pure water supplies is of the most vital importance. Economically as well as from a public health standpoint, pure water is a necessity. Without it abnormal conditions may develop in the milk, as well as the possibility of a milk-borne epidemic.

A sanitary survey of the water supply of all farms shipping milk to the city should be made. The inspector must be capable of determining whether the location of the source of supply is such as to be free from surface drainage. The slope of the ground in relation to surroundings and seepage should be studied. Samples of water should be taken in sterile, glass bottles. An 8-ounce, small-top, ground-glass stoppered bottle is preferable for the work. The sample should be procured aseptically, immediately packed in crushed ice, and taken to the laboratory. The bacteriological analysis should consist in determining the total count, number of acid organisms, and presence or absence of the *B. coli* group, and, if present, whether of fecal type. If results show that the water is polluted or even suspicious the supply should be condemned and the milk from that farm refused admittance to the community until a satisfactory water supply has been procured.

One examination of the water supply is not sufficient. Due to physical and chemical forces, the nature of a supply varies from season to season. Inspectors should keep this fact in mind.

THE SCORE CARD IN MILK-PLANT INSPECTION.

The scoring of dairy farms has become so effective and popular that the principle has been extended to other phases of dairy inspection. The Department of Agriculture has devised and used for several years a score card for rating establishments and methods of city milk dealers, which is shown below:

[Front of card.]

[United States Department of Agriculture, Bureau of Animal Industry, Dairy Division.]

SANITARY INSPECTION OF CITY MILK PLANTS.

SCORE CARD.

Owner or manager_____

Street and No._____

City_____ State_____

Trade name_____

Number of wagons_____ Gallons sold daily { Milk_____ / Cream_____

Permit or License No._____

Date of inspection_____, 192__.

Remarks: _____

_____

_____, *Inspector.*

[Back of card.]

Equipment.	Score. Perfect.	Score. Allowed.
BUILDING:		
Location: Free from contaminating surroundings	2	
Arrangement	7	
Separate receiving room 1		
Separate handling room 2		
Separate wash room 1		
Separate sales room 1		
Separate boiler room 1		
Separate refrigerator room 1		
Construction	12	
Floors tight, sound, cleanable 2		
Walls tight, smooth, cleanable 1		
Ceilings smooth, tight, cleanable 1		
Drainage 2		
Floors 1		
Sewer or septic tank 1		
Provision for light 2 (10 per cent of floor space.)		
Provision for pure air 2		
Screens 1		
Minimum of shafting, pulleys, hangers, exposed pipes, etc 1		
APPARATUS	15	
Boiler 2 (Water heater, 1.)		
Appliances for cleansing utensils and bottles 2		
Sterilizers for bottles, etc 2		
Bottling machine 1		
Capping machine 1		
Washbowl, soap, and towel in handling room 1		
Condition 6		
Milk-handling machinery 3		
Pipes, couplings, and pumps 2		
Cans 1		
LABORATORY AND EQUIPMENT	2	
WATER SUPPLY	2	
Clean and fresh 1		
Convenient and abundant 1		
Total	40	

Methods.	Score. Perfect.	Score. Allowed.
BUILDING	14	
Cleanliness:		
Floors 3		
Walls 2		
Ceilings 2		
Doors and windows 1		
Shafting, pulleys, pipes, etc 1		
Freedom from odors 2		
Freedom from flies 3		
APPARATUS	7	
Cleanliness:		
Thoroughly washed and rinsed 3		
Milk-handling machinery 2		
Pipes, cans, etc 1		
Sterilized with live steam 3		
Milk-handling machinery 2		
Pipes, cans, etc 1		
Protected from contamination 1		
BOTTLES	7	
Thoroughly washed and rinsed 3		
Sterilized with steam 15 minutes 3		
Inverted in clean place 1		
HANDLING MILK	22	
Received below 50° F 3 (50° to 55°, 2.) (55° to 60°, 1.)		
Rapidity of handling 2		
Freedom from undue exposure to air 2		
Cooling 5		
Promptness 2		
Below 45° F 3 (45° to 50°, 1.)		
Capping bottles by machine 2		
Bottle top protected by cover 1		
Storage; below 45° F 4 (45° to 50°, 3; 50° to 55°, 1.)		
Protection during delivery 2 (Iced in summer.)		
Bottle caps sterilized 1		
INSPECTION	6	
Bacteriological work 3		
Inspection of dairies supplying milk 3 (2 times a year, 2; once a year 1.)		
MISCELLANEOUS	4	
Cleanliness of attendants 2 (Personal cleanliness, 1; clean, washable clothing, 1.)		
Cleanliness of delivery outfit 2		
Total	60	

Score for equipment ..... plus score for methods ..... equals TOTAL SCORE .....

NOTE.—If the conditions in any particular are so exceptionally bad as to be inadequately expressed by a score of "0" the inspector can make a deduction from the total score.

What has been said of the advantages and use of the score card in dairy-farm inspection applies, with equal force, in milk-plant inspection. Several features connected with this phase of the work are of such importance as to deserve special attention.

In order that plenty of air and light may be admitted the window surface ought to be at least 10 per cent of the floor area in rooms where milk is handled.

The best arrangement of the plant is such as to allow the several processes, viz, receiving, pasteurizing, washing, selling, etc., to be

carried on in separate rooms. A perfect score can be given only where such arrangement is present.

A network of shafting and belting is undesirable.

In examining apparatus as to its cleanliness, piping, vats, coolers, and bottle fillers should receive special attention. Milk pipes should have frequent hand couplings and be of smooth, sanitary construction and be taken apart daily for cleaning.

Milk pumps which are simple in construction and easily taken apart are preferable. It is necessary to take such apparatus apart daily for thorough cleaning and sterilizing.

All apparatus coming in contact with milk must be thoroughly cleaned and sterilized immediately after using. Empty bottles and cans may be the source of great contamination. Thorough sterilization of all bottles and cans before filling is necessary. Proper facilities for this purpose should be in every plant. It is the best practice to provide a clean place free from contamination for storage of bottles and cans.

In pasteurizing establishments time and temperature recording apparatus should be present and proper control exercised as described later.

The handling of the milk is very important. Twenty-two points out of a total of 60 given to "methods" are allotted to this factor. With all necessary equipment the score can not be high if the handling of the milk is not satisfactory. Complete records should be kept and filed. In general, the same methods adopted for the final recording and filing of reports of farm inspection can be satisfactorily used in milk-plant-inspection work.

LABORATORY CONTROL.

THE MILK OR DAIRY LABORATORY.

A health department without milk-laboratory equipment and a trained and efficient laboratory personnel is practically useless so far as proper control and study of the milk supply are concerned. The ordinance, with its milk code, and the inspection force are agencies used in bettering and making safe a milk supply. The laboratory points out the proper direction for the work to take and is the means by which it is possible to judge the results obtained. The lack of a laboratory leaves all milk control mere guesswork so far as final results can be determined. An efficient laboratory is equipped to make physical, chemical, and bacteriological analyses of milk and also bacteriological and sanitary analyses of water supplies. All records should be permanently filed and duplicates sent to the interested producer or distributor.

LIST OF EQUIPMENT FOR MILK LABORATORY.

The following is a list of equipment necessary to equip a milk laboratory properly in the average small city. No estimate as to price is given, but health departments interested are advised to write to chemical and bacteriological supply houses for estimates.

Chemical apparatus:

1 analytical balance with weights—1 milligram to 100 grams.
1 cream test scale.
1 balance with weights to 5 kilos.
1 Westphal balance or accurate lactometer with cylinder.
1 Babcock milk-fat tester—12 bottles.
36 milk-test bottles, 8 per cent (standardized for accuracy).
12 cream test bottles, 9 grams, 50 per cent.
1 thermometer, range, 10° to 200° C.
1 thermometer, range, 10° to 110° C.
1 thermometer, range, 0° to 212° F.
1 water bath for milk solids, 12 holes.
1 drying oven, double wall.
1 wash bottle, 1 liter.
2 pipettes, 17.6 c. c.
1 pair dividers.
1 combined acid bottle and pipette.
2 burettes, 50 c. c. graduated in tenths.
1 burette holder.
24 beakers, lipped—assorted sizes (100 to 250 c. c.).
12 porcelain dishes, flat bottom.
2 beakers, lipped, 500 c. c.
2 beakers, lipped, 1,000 c. c.
2 iron supports, with sets of 4 rings, Nos. 2 to 4.
1 desiccator.
1 refractometer.
1 sediment tester and 1,000 cotton disks.
12 glass stirring rods.
1 pipette, 5 c. c.
1 pipette, 10 c. c.
1 pipette, 25 c. c.
1 pipette, 50 c. c.
2 iron tripods.
25 lengths, 2 meters each, glass tubing, assorted sizes, 2 to 4 mm.
6 wire gauze, asbestos center.
1 pair crucible tongs.
6 Bunsen burners.
24 feet rubber tubing, thick wall, cloth wrapped, $\frac{1}{4}$ inch.
6 funnels glass, diameter 8 cm.
1 pack filter paper—12.5 cm. diameter, for qualitative analysis.
1 pack filter paper—25 cm. diameter, for qualitative analysis.
1 funnel, 6 inches.
12 reagent bottles.
4 test-tube cleaning brushes.

Bacteriological apparatus—

1 microscope with accessories.
6 inches platinum wire.
1 water bath for melting agar tubes.
1 autoclave with burner.
1 Arnold sterilizer.
1 dry-air sterilizing oven.
1 incubator.
100 1 c. c. pipettes graduated in tenths with extra tenth above 0 mark, to deliver between two marks.
200 test tubes, lipless, heavy wall to withstand sterilization.
4 test-tube baskets.
4 pipettes—5 c. c. to 50 c. c. (See chemical list.)
1 cylinder, 1,000 c. c. graduated.
1 cylinder, 100 c. c. graduated.
24 Erlenmyer flasks, 300 c. c.
6 Erlenmyer flasks, 1,000 c. c.
48 glass bottles, glass stoppered, 6 ounces.
1 double boiler, granite ware, $\frac{1}{2}$ gallon.
200 Petri dishes, 100 by 10 mm.
2 Petri-dish boxes, sheet iron, capacity 50 each.
2 pipette boxes.

Bacteriological apparatus—Continued.
1 reading glass—4 inches, 2½ magnifications.
1 counting plate.
1 counter.
1 gas stove, single burner.
Burners and tubing. (See chemical list.)
2 wax pencils.
Chemical reagents and solutions—
Commercial sulphuric acid; sulphuric acid, c. p.; hydrochloric acid, c. p.; nitric acid, c. p.; sodium hydroxide, normal; sodium hydroxide, tenth normal; hydrochloric acid, normal; hydrochloric acid, tenth normal; Phenolphthalein indicator; calcium chlorid; acetic acid, glacial; potassium bichromate; peptone; beef extract; agar, shredded; absorbent and nonabsorbent cotton; microscopical stains; grams (set of reagents); methlyene blue and fuchsin; stronger ammonia water; borax or boric acid; ether; ferric chloride, crystals; litmus paper, red and blue; turmeric paper; alcohol, 95 per cent; phenol, pure crystals.

COLLECTION OF SAMPLES.

The status of any milk supply is judged by the samples taken. It is therefore imperative to procure and analyze proper and representative samples. Fortunately most of the milk supply is delivered in bottles to consumers. In this case the collection of samples is comparatively simple. The inspector should select at random two pint bottles from a delivery wagon of each dealer. Provided the milk before bottling has been properly handled and processed these samples represent fairly the dealer's whole supply. If the bottles do not have a uniform appearance it is the inspector's duty to learn the reason and instruct the dealer according to his findings. One bottle should be immediately opened and the temperature taken. It should then be sealed and used for chemical analysis. The unopened bottle should be immediately placed in crushed ice or otherwise kept below 40° F., as this sample is for bacteriological analysis, and carried or sent to the laboratory as soon as possible. Samples should always reach the laboratory within three hours after procurement.

Samples should be taken from every dealer at frequent intervals, the oftener the better. In addition to samples obtained from the wagons, bottled milk from stores and shops should be taken. By so doing a check is made upon the character of the milk and the care given it at such stores and shops. Valuable data can be obtained at the time these samples are taken. Methods used for keeping the milk cold, protection from contamination, and time of delivery and sale are matters which are of importance to milk-control officials.

The sampling of bulk milk and cream presents greater difficulties. The samples must be representative and for bacteriological examination must be taken under aseptic conditions. In collecting samples for both bacteriological and chemical examinations, those for bacteriological examination are taken first. For such samples 4-ounce, wide-mouthed glass-stoppered bottles are recommended. Stoppers, of the mushroom type, fastened in place by paper covers, are very satisfactory. Both sampling apparatus and bottles must be sterilized by means of hot air at a temperature of at least 170° F., for one and one-half hours. The following results of experiments conducted by the research laboratories of the Dairy Division show the average bac-

terial counts when different methods were used in collecting samples from a 5-gallon can of milk:

TABLE 1.—*Average bacterial counts of milk samples obtained by different methods of collecting samples.*

Method of collection.	Bacterial counts on plain agar.
	Fresh milk.
	Bacteria per c. c.
Using 25 c. c. sterile pipette without shaking contents of can	1,100
Inserting sterile tube, keeping finger on top end; released when other end of tube reaches bottom of can	700
Sterile tube extended through milk layer without finger on top except to withdraw sample [1]	5,500
Shaking contents of can and using 25 c. c. sterile pipette [1]	4,100

[1] Either method satisfactory.

Where bulk milk is well mixed, samples may be taken by means of a pipette. Mixing may be done by means of a metal rod with a detachable disk on the end. The disks and rods are sterilized in separate boxes, the disks being placed so that the handles can be screwed in without touching the former with the hands. When boxes for holding are not available, both disks and handles may be wrapped in paper and sterilized, care being taken to prevent contamination. When the sample is to be mixed a rod is withdrawn from its box and screwed into a sterile disk in the disk box. One sterile stirring rod is necessary for each sample. Shaking a 5 or 10 gallon can of milk is difficult and is liable to cause spilling. A good method of collecting a sample of bulk milk for bacteriological examination is to insert into the milk a sterile glass or metal tube long enough to reach to the bottom of the milk. The thumb or finger is then placed over the end, and the tube with its contents withdrawn and emptied into a sterile glass bottle. For a 10-gallon can a tube 22 inches long and three-eighths inch in diameter will withdraw about 20 cubic centimeters of milk, which is sufficient for bacteriological examination. These rods can be wrapped separately and sterilized, or a special box to hold a number of them can be used.

The collection of samples of bulk milk for chemical analysis does not require sterile apparatus but is always advisable. Rods with disks or long-handled dippers should be used for mixing. Six-ounce or eight-ounce, wide-mouthed, glass-stoppered bottles are best for sample bottles. The use of narrow-neck bottles requires the use of a funnel.

It is advisable for the inspector to use some method for sealing samples. This seal should bear an official number. Sealing is especially important to assist in connection with evidence valid in court cases. Records must be kept in order that the sample can be identified.

LABORATORY ANALYSIS.

As soon as samples are received at the laboratory they should be "plated." It is essential that bacteriological analysis be made as

soon as possible after taking the samples. Samples must be kept below 40° F. from the time they are obtained until they are plated. This applies to keeping samples in the laboratory as well as to their transportation.

Methods used in chemical analysis are described in Bureau of Animal Industry publication A–12 entitled "Chemical testing of milk and cream." The specific gravity, fat, solids not fat, total solids, acidity, and presence or absence of preservatives should be determined. Other factors, as the refractive index and freezing point, are usually determined in the large laboratories. These tests are used in determining adulteration by skimming or watering. The greater the number of facts determined concerning any sample, the less chance there will be of allowing any milk which falls below standard to reach the consumer.

After the bacteriological analysis of any sample has been made the remainder of the sample can be used for a sediment test. This test may also be made with the milk taken for chemical analysis. The test consists in filtering milk under slight pressure or vacuum through a cotton disk.

Because the amount of visible dirt or sediment, as shown by the sediment test, does not necessarily indicate the bacterial count of individual samples of milk, it should not be assumed that such test should be neglected or its use curtailed. The sediment test is important and should be carried out by all milk laboratories. The sediment test can be made in the field by the inspectors and will prove valuable in educational work with the producer. It is a test which can be made at the farm to demonstrate the cleanliness or carelessness of the methods used. By being shown the actual amount of dirt present the producer is more easily convinced that his methods are at fault. Owing to the general use of clarifiers or filters by milk plants the sediment test has lost a great degree of its significance in city inspection.

The sediment tester is very simple in construction and operation. Various makes are on the market. Some are adapted for laboratory use only; with this type a large number of samples may be tested in a short time. Others are adapted for field work and find their greatest use at receiving platforms and on farms. The sediment disks are given a rating and records of same filed. The rating is determined by comparing the disk with a standard series of prepared disks which have been given numerical values. Such a standard may be prepared by the board of health or reference made to the series given in United States Department of Agriculture Circular No. 53, "Milk and Cream Contests."

LABORATORY CONTROL OF PASTEURIZATION.

It is desirable that health officials have an intimate knowledge of pasteurizing plants and their operation and not to rest assured of a safe product because of the mere presence of such a plant in their city. Special attention should be given to the operation of these plants because they are possible centralized sources for the dissemination of communicable diseases.

Control of the process of pasteurization and study of the condition of subsequent containers and contact surfaces are essential. Frequent inspections with analyses should be made by a trained bacteriologist, and a constant check upon this work by the health officer is necessary.

In considering the efficiency of pasteurizing processes it must be understood that the percentage reduction of bacteria in milk due to heating does not form a conclusive guaranty of safeness of the final product. Any inoculation subsequent to the heating process introduces an uncertain element which may be of a serious nature and may void the reduction in bacteria previously obtained.

The purpose of bacteriological control is to ascertain the degree of reduction of bacteria due to heating and also the amount of contamination after pasteurization.

In order to control pasteurization properly a recording thermometer, indicating time as well as temperature, is necessary. To check the accuracy of the thermometer frequent comparison must be made with a standard thermometer. The point of attachment of the bulb (of the thermometer in the vat) varies with different apparatus, and records obtained should not be accepted as final evidence that the entire quantity of milk has received the maximum degree of heat until time of filling is known. Each installment presents a separate problem. When the temperature record extends over a period of time, as in the case of vat holders, the charts usually record from the time the milk enters the vat until the milk leaves it. In instances where the temperature of the milk reaches the pasteurizing temperature before the vat is full a direct time reading from the recording chart is misleading. The correct reading is computed from the time the vat is full until the vat begins to empty. Since all the milk is to be held 30 minutes, this will result in some milk being held longer than the required time, as the temperature remains high while the vat is emptying; but in the vat system this is the only positive method of assuring that all the milk receives the minimum required treatment.

The continuous-flow type of pasteurizer presents a different problem. The thermometer bulb is usually placed at the entrance of the apparatus. Personal observation must be made to determine the time of holding.

When the heating temperature is controlled by hand valves the constant presence of the operator is necessary in order to avoid wide fluctuations in heating temperature. Even with the greatest care slight variations can not be avoided.

Special precautions to see that pasteurizing charts are not tampered with is important. It is possible to mark these charts by hand or to place the pen so that the temperature recorded does not show the true temperature. Careful study of the charts, with frequent observations at the plant, reveals such practices.

The following series of samples should be taken at each pasteurizing plant and examinations made as indicated:

1. Raw milk at entrance of heater, for bacteria and temperature.
2. Heated milk, after being held, for bacteria, time of holding and temperature.

3. Milk as it comes from the cooler, for bacteria and temperature.
4. Milk as it leaves the bottling machine, for bacteria.
5. Milk in cans or bottles, for bacteria and temperature. Observe length of time before placing in storage.
6. Milk in bottles or cans after storage, for bacteria. Observe length of time of storage and temperature.
7. Bottles or other final containers before the addition of milk, for bacteria to determine the efficiency of washing and sterilization.

A study of the results obtained from these samples will show the condition of the raw milk before pasteurization, the efficiency of the pasteurization process, and the efficiency of methods used in subsequent handling of the product. The results will indicate the degree of care used in cleaning cooler and bottles and efficiency of sterilization of cans and bottles.

RECONTAMINATION AFTER PASTEURIZATION.

The surfaces of the cooler, bottling machinery, and the final container may add more bacteria to the product than efficient pasteurization has destroyed. The cooler and bottle are common sources of recontamination. The cooler, with its extensive surfaces, and the bottle filler, with its numerous valves, are difficult to clean. Such apparatus needs to be as near sterile as possible, because any contamination from these sources, whether pathogenic or nonpathogenic, will be carried directly to the consumer. It is the best policy to keep the milk from undue exposure to air after pasteurization. Covering surface coolers is desirable.

After coolers and bottling machinery have been cleaned and sterilized the inspectors should collect, in an aseptic manner, drainage water from the trough of the coolers and the bottling machinery. These samples should then be iced and taken to the laboratory. The results of bacteriological examinations will indicate the efficiency of cleaning and sterilization.

To place either raw or pasteurized milk in an insanitary final container is to make futile all previous efforts for bacterial control. It is possible to sterilize milk bottles and cans, and this should be made compulsory. In a number of cities it is illegal for the consumer to use milk bottles for any other purpose than for holding milk. The enforcement of this regulation, however, is often neglected and milk bottles are put to countless uses, some of which are far from sanitary. The bottles as returned to the milk plants are, in some cases, in an extremely insanitary condition. All milk bottles need to be sterilized before refilling.

No milk bottles should be returned to dealers from houses harboring contagious disease until the bottles have been released by the health department. Four practical methods are open for the health department to follow in dealing with this problem. First, delivery of milk in a single-service container, which is to be burned immediately after use; second, sterilization of the bottles at the residence; third, sterilization of the bottles by the board of health; fourth, pouring the milk by the delivering agent from a bottle into a properly covered receptacle placed for that purpose at the residence, the driver not to handle the receiving container.

The use of the single-service container should be encouraged in such cases. By its use and proper disposal there is no danger of the spread of contagious disease from one consumer to others.

When the bottles are held, and then sterilized at the house, the sterilization should be carried out under the direct supervision of the board of health. If not so done, it is probable that the bottles will be returned to the dairyman without proper sterilization. Many persons do not understand the necessity for such sterilization and do not know the proper methods to use in such cases. Leaving directions that all bottles must be sterilized, without seeing that the directions are carried out, is a dangerous procedure for any board of health to take.

When bottles are sterilized by the board of health the results should be satisfactory. The strictest care should be taken with such bottles, however, from the time they leave the residence until they are properly sterilized.

The method of pouring milk from the bottle into another receptacle at the residence is open to just criticism upon the grounds that the driver may come into direct contact with a receptacle which perhaps has been open to exposure of contamination. Such a condition might give serious results.

The single-service container is the preferable way to handle this problem. If such container is not used, the responsibility of sterilizing the glass bottles rests upon the board of health.

In order to determine the sterility of bottles and cans frequent tests must be made, which is done by rinsing bottles and cans thoroughly with sterile water. A definite quantity of water is used for rinsing (20 cubic centimeters for bottles and 1 pint or 500 cubic centimeters for cans has given satisfactory results). After the water has been placed in the can or bottle, which is then sealed, the receptacle is thoroughly rinsed by vigorous shaking, and in the case of cans, shaking and rolling. Samples of the rinse water thus obtained should be iced properly and taken to the laboratory, where bacteriological analysis is made, and by the use of the following formula the contamination per cubic centimeter of contents of bottle or can is calculated:

$$\frac{\text{Bacteria per c. c.} \times \text{c. c. of water used}}{\text{c. c. in container.}} = \text{contamination per c. c. milk.}$$

Ten gallons=37,854 cubic centimeters.
One quart =946.4 cubic centimeters.

A systematic examination of cans returned by milk plants to shipping stations and direct shippers should be made. Such examinations can be made at the railroad station just before the cans are loaded on the outbound trains. In this way the inspector can check up the sterilization of cans at the plants.

Control and supervision of the milk supply are not completed until the milk has reached the consumer. Pasteurization, cooling, bottling, and condition of the final container and delivery are all essential factors in the control of the supply. Inefficiency in any one process may result in a high bacterial count and possible danger to the consumer.

MEDICAL INSPECTION OF EMPLOYEES.

Milk inspection is not complete until the health of all persons handling milk or milk containers has been considered. Frequent medical inspection of employees is an important phase of milk-control work. This applies to those who are employed on the farms and may come in contact with milk that is to be sold raw and also to those employed in city milk plants.

Milk may be infected by persons who are suffering from a mild form of some infectious disease and who themselves handle pasteurized milk or apparatus with which the milk comes in contact, or by carriers who, while they are free from the disease, harbor the organisms which may be carried into the milk. If persons of either of these two classes are employed in milk plants the way is open for the spread of the disease through the milk. Such persons would not ordinarily find employment in milk plants if their condition were known, but it is not possible to eliminate such persons without resorting to a medical examination. Such medical examinations have been neglected in many communities and in others have been carried out only perfunctorily. The expense connected with medical inspection and the fact that many communities have been fortunately free from milk-borne epidemics are probably the reasons for the absence of proper medical inspection of milk-plant employees. Both reasons have little weight when the dangers resulting from lack of such inspection are considered.

Without a thorough system of periodic medical inspection of employees, even though the pasteurizing process is closely supervised, the pasteurized milk supply of a community can not be said to be safe.

The examination of all persons handling raw-milk supplies is of equal importance. In this case the protection which may be given by pasteurization is absent. Even a superficial study of milk-borne epidemics will convince the most skeptical that medical inspection of all persons coming in contact with milk or milk containers is a paramount feature of milk inspection.

SUMMARY.

Improper methods of production and handling of milk may cause danger to the public health. For this reason milk inspection is important to the community.

Milk inspection has reached the point in its development where three distinct features are now practically essential. These features are: Dairy inspection, dairy instruction, and laboratory control.

Dairy-farm inspection regulates the condition surrounding the source of the supply. Without it the safety of the finished product can not be assured.

The growth of our cities has compelled them to obtain milk from farms at greater and greater distances and has resulted in increasing the number of the city milk plants. These milk plants must be controlled as well as the farms.

To carry on the work of the health department an efficient and thoroughly trained staff of inspectors, laboratory workers, and assistants is necessary.

The instrument giving legal right to control the milk supply of a community is the milk ordinance. This should be practicable, reasonable, and enforceable.

The score-card system of dairy-farm inspection has proved to be beneficial in the improvement of milk supplies. It is an aid to the producer, distributor, health official, and consumer.

The dairy-farm score card is a guide by which the inspector can impartially appraise, from a sanitary viewpoint, the equipment and methods used in producing milk on the farm, and it can be used profitably by the producer to learn how to improve such equipment and methods.

A thorough sanitary survey of the water supplies of all farms producing milk should be made. All suspicious or dangerous supplies should be condemned.

The advantages and use of milk-plant score cards are similar to those of the dairy-farm score card, and the results, if properly used, will guide inspectors in the handling of milk in city milk plants.

Without a milk laboratory properly equipped and conducted, the work of milk control is seriously handicapped. The laboratory results show the need for improvement of the milk supply, and also show the status of the present supply.

The procuring of samples is a most important feature of milk control work, as the accuracy of the laboratory results depends upon the accuracy and authenticity of the samples collected by inspectors.

Pasteurizing plants may be possible centralized sources for the dissemination of communicable disease. For this reason the processes carried on at such plants and the results obtained should be carefully controlled by means of laboratory analyses of samples obtained at the pasteurizing plants and of samples procured on the streets and in shops.

As recontamination after pasteurization may prove serious, the milk-control officials should make frequent and methodical examinations of apparatus, bottles, and cans with which the milk comes in contact after pasteurization. Laboratory control of this phase of the work is essential.

Those who handle milk or milk containers on farms where milk is sold for use in its raw state or in pasteurizing plants should be subject to frequent medical inspection.

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